

# Constellation

The Constellation X-ray Observatory

## ►► TES Development at NIST for the XMS

*Kent Irwin*

*National Institute of Standards and Technology*

**NIST**  
National Institute of  
Standards and Technology



## People

### NIST

Kent Irwin

Jim Beall

Randy Doriese

William Duncan

Gene Hilton

Ben Mates

Galen O'Neil

Carl Reintsema

Dan Schmidt

Joel Ullom

Leila Vale

Yizi Xu

### GSFC

Richard Kelley

Caroline Kilbourne

Simon Bandler

Scott Porter

Kevin Boyce

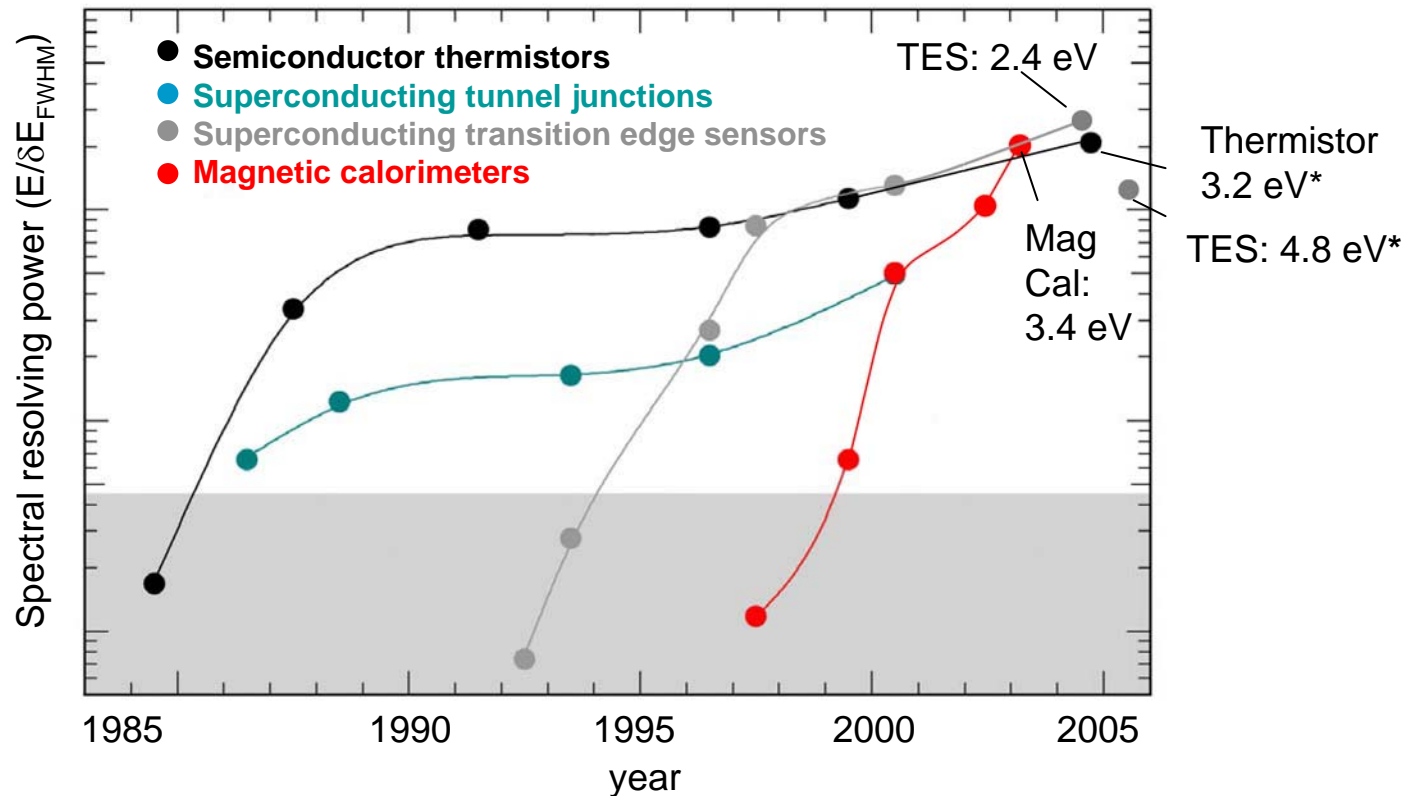
Jay Chervenak

Fred Finkbeiner

### MIT

Professor E. Figueroa

## $E/\delta E$ at 6 keV: the *correct* plot

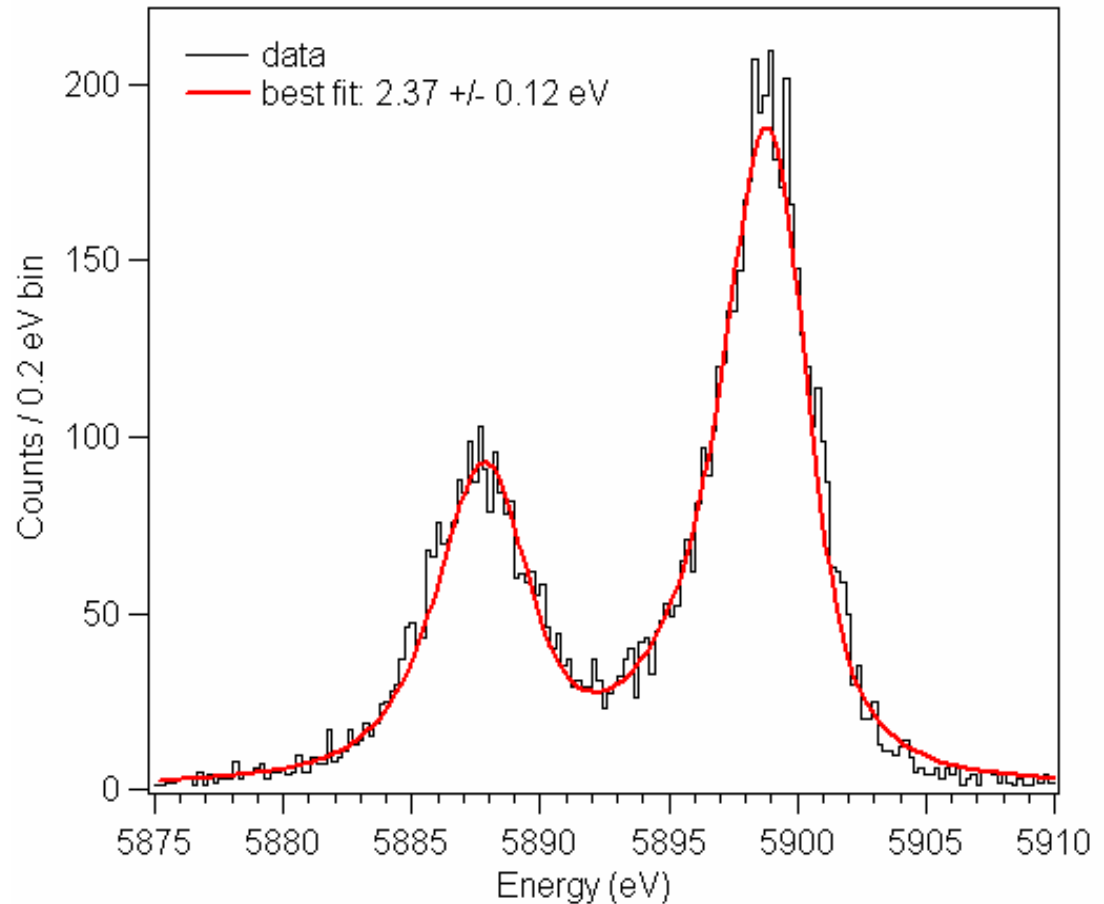


ionization detectors

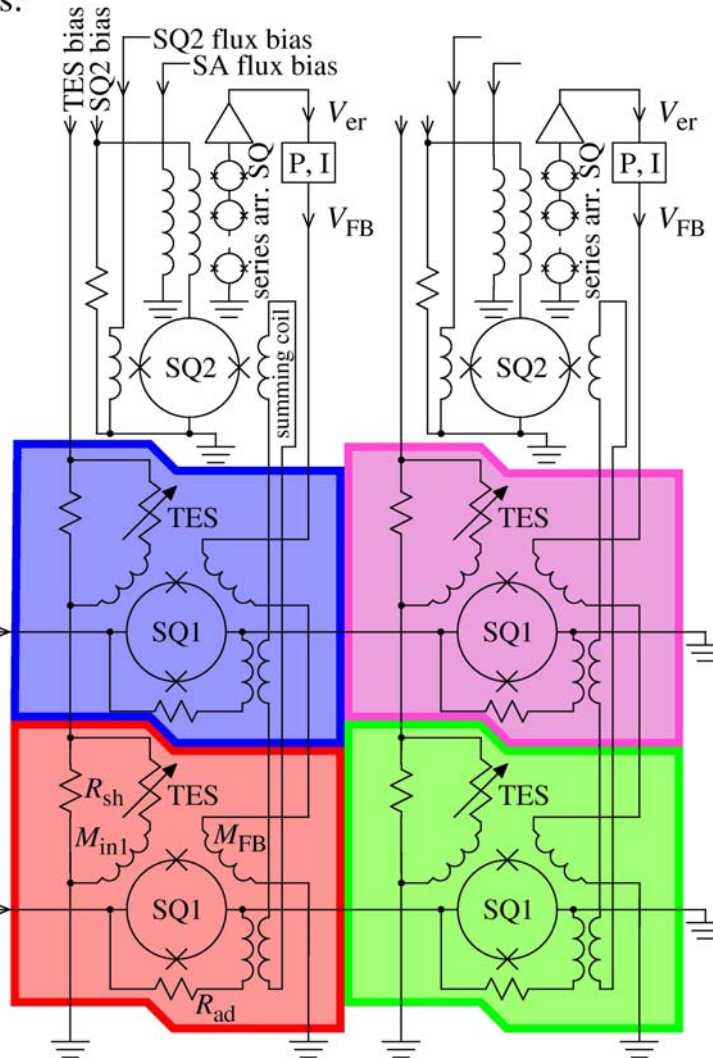
\* These devices meet Con-X requirements for quantum efficiency

## TES energy resolution at 6 keV

**$2.37 \pm 0.12$  eV FWHM**



Data has also been analyzed in a “round robin” with GSFC and the Heidelberg group with similar fit results



- 5



Column  
outputs:

Row address  
currents:

Row 1

Column 1

Column 2

Column 1

VER

time

Column 2

 $V_{FB}$ 

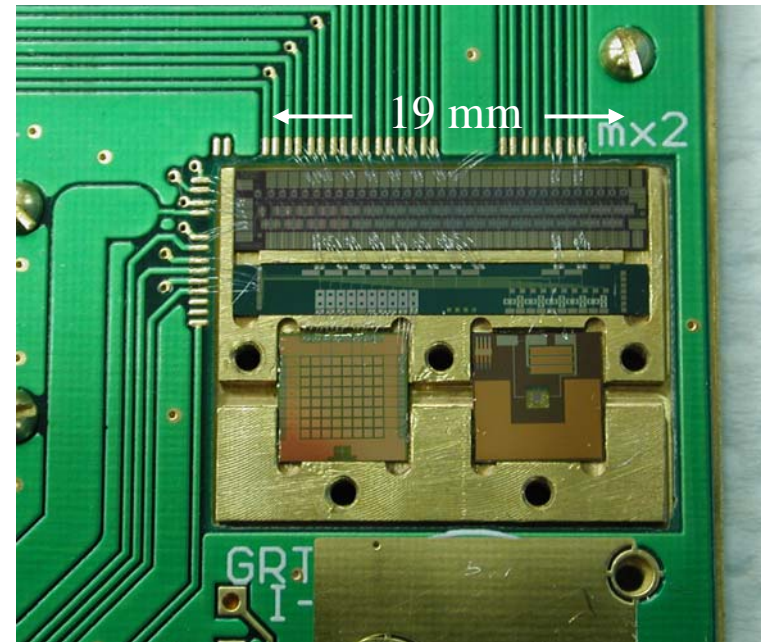
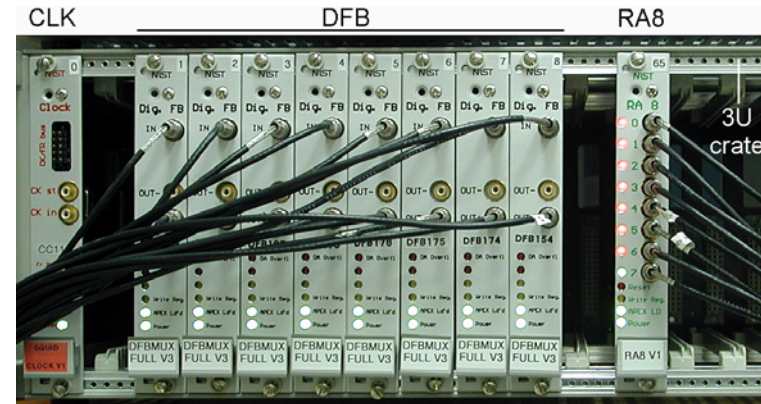
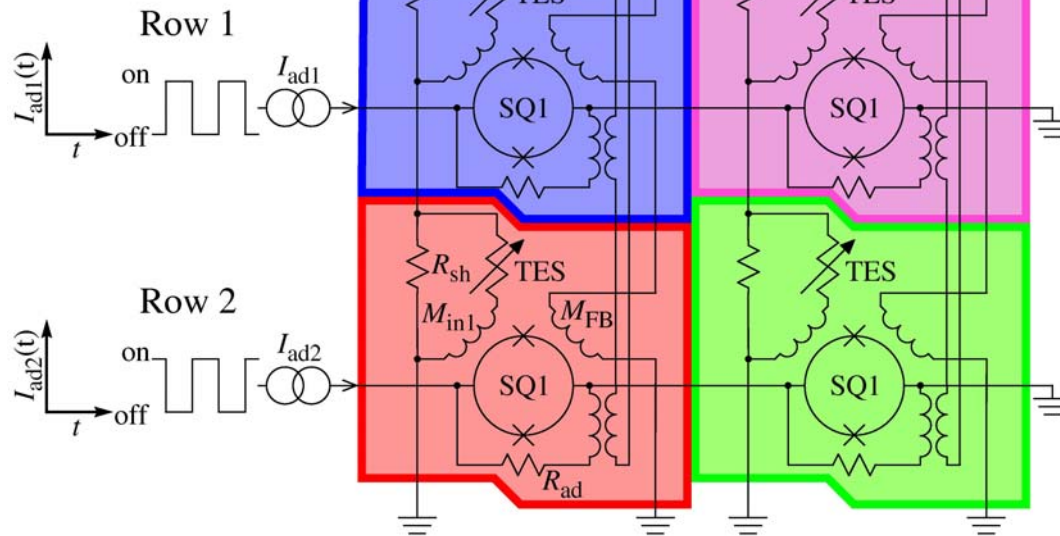
time

# SQUID MUX architecture

Column outputs:

Each colored block is 1 pixel

Row address currents:





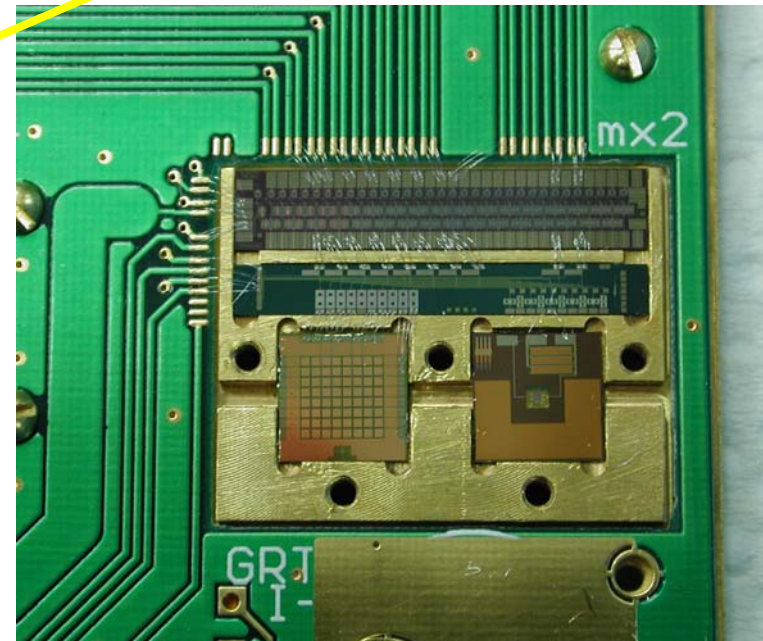
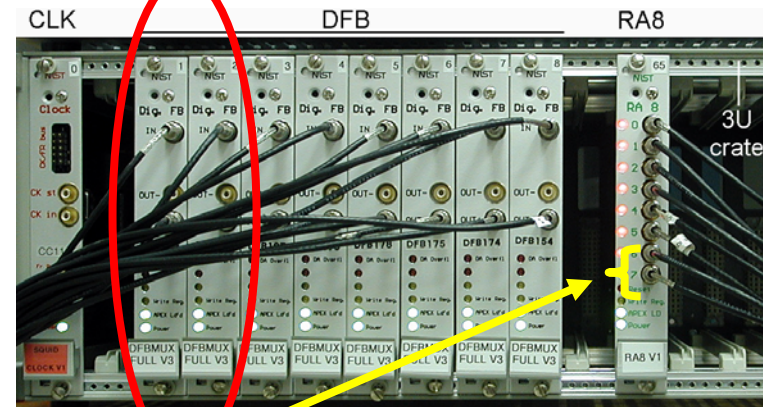
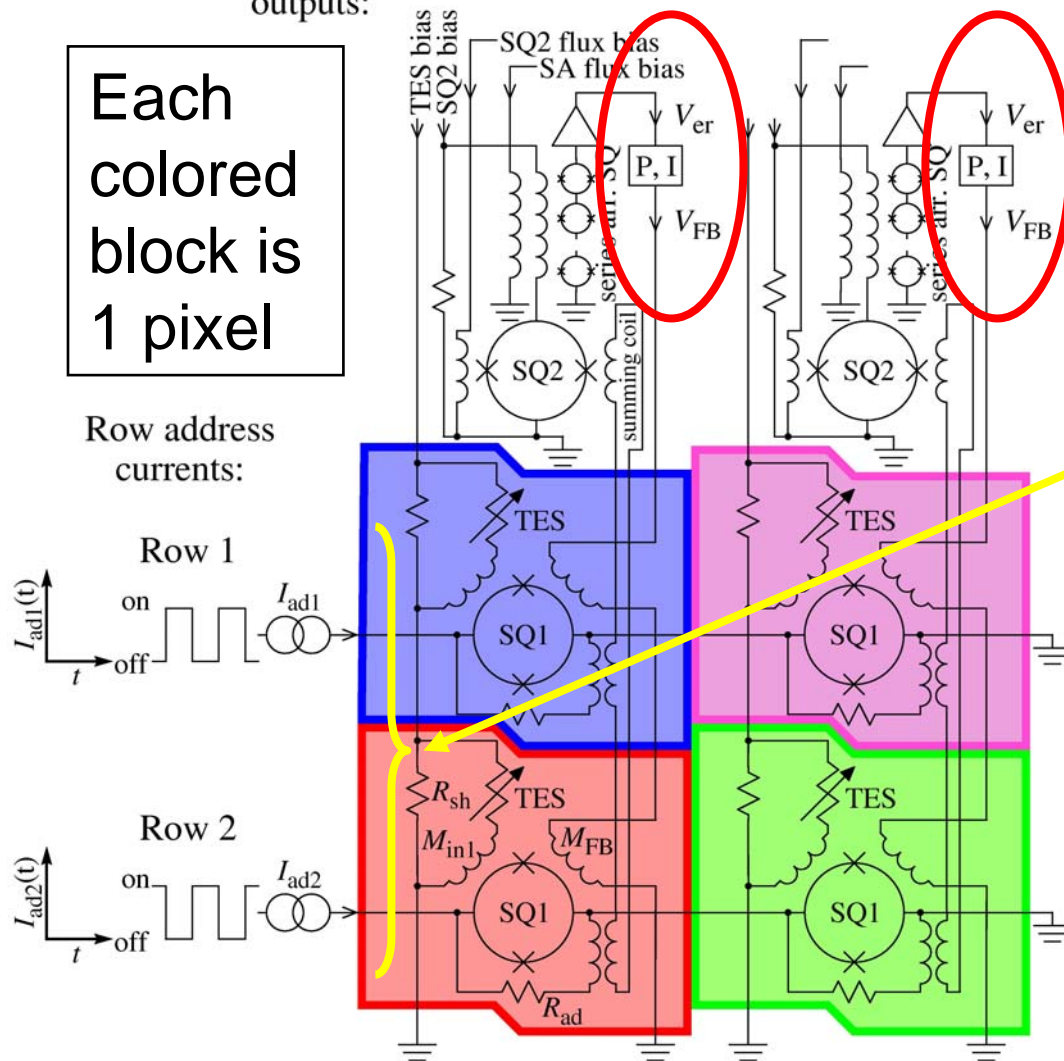
# SQUID MUX architecture

Column outputs:

Each colored block is 1 pixel

Column 1

Column 2





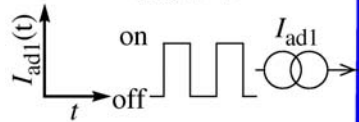
## SQUID MUX architecture

Column  
outputs:

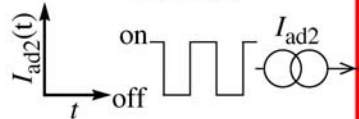
Each  
colored  
block is  
1 pixel

Row address  
currents:

Row 1

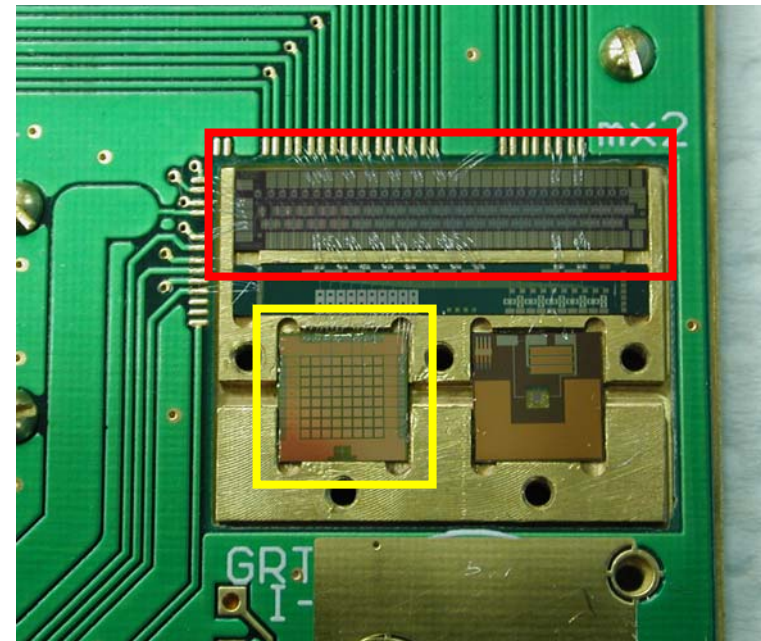
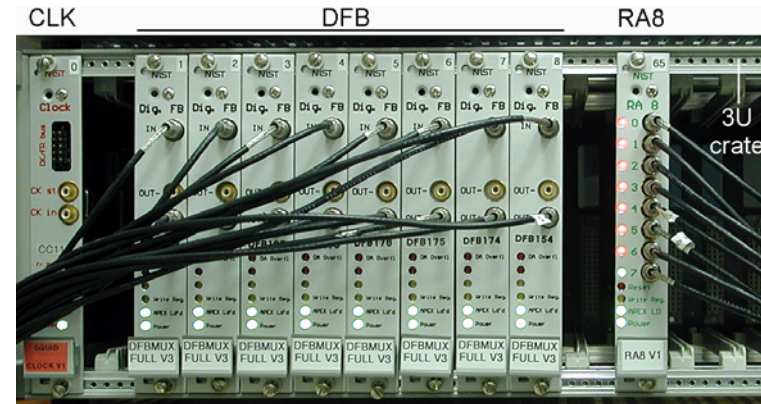
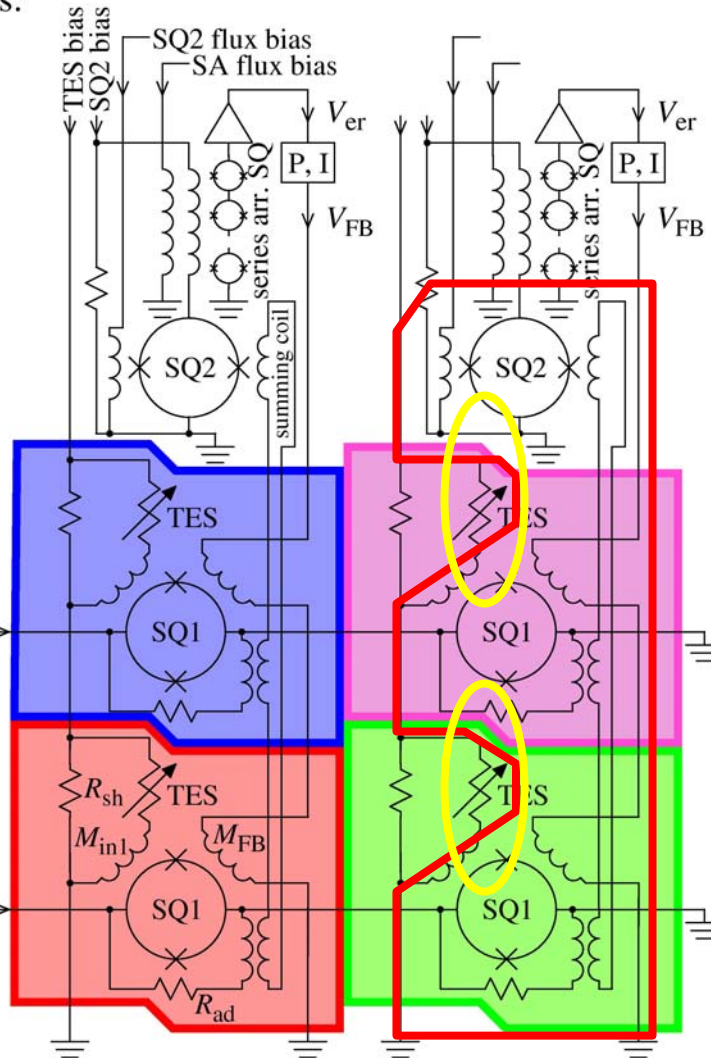


Row 2



Column 1

Column 2



# SQUID MUX architecture

Column outputs:

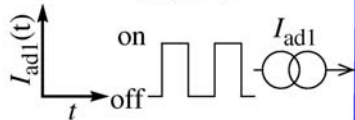
Column 1

Column 2

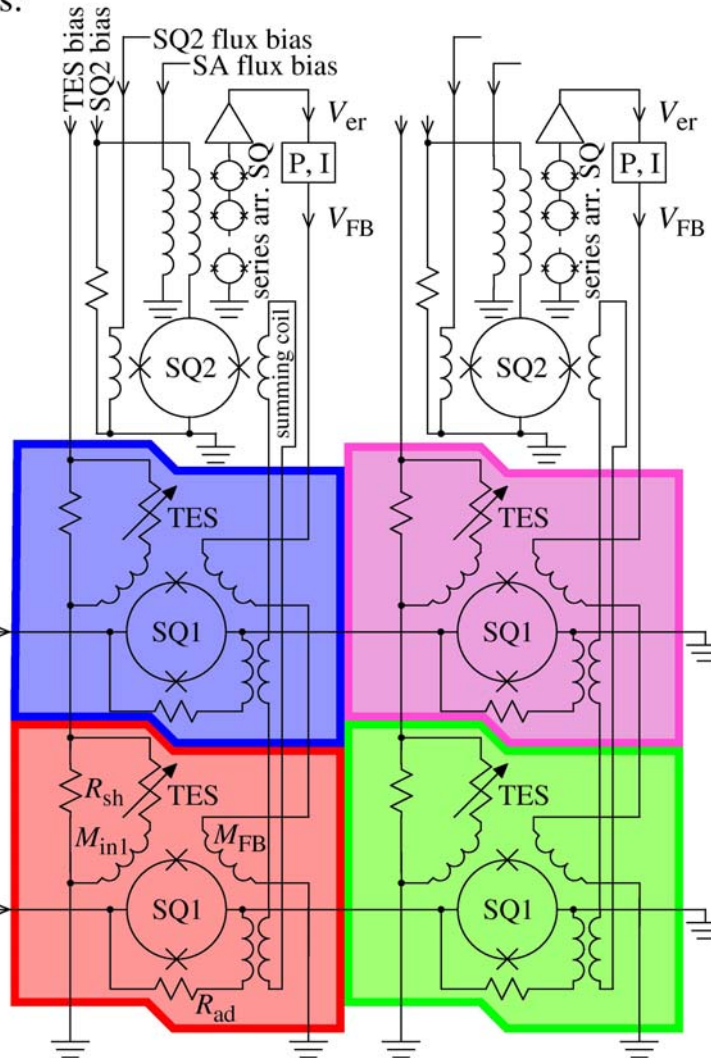
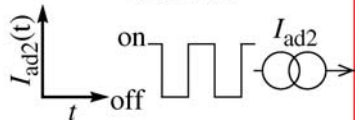
Each colored block is 1 pixel

Row address currents:

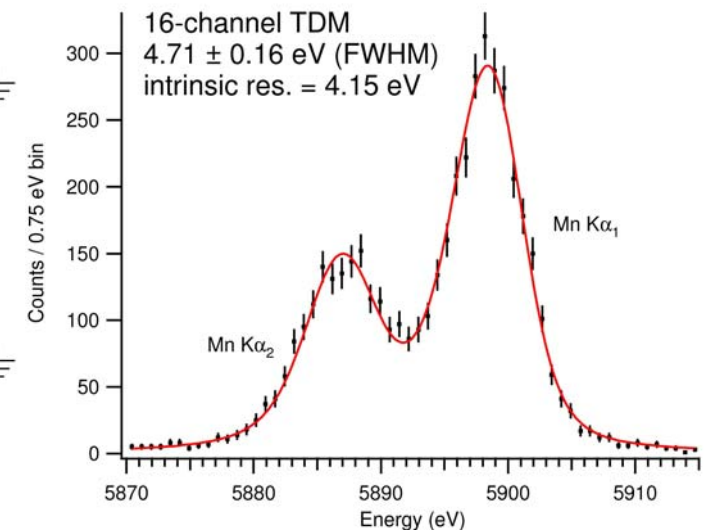
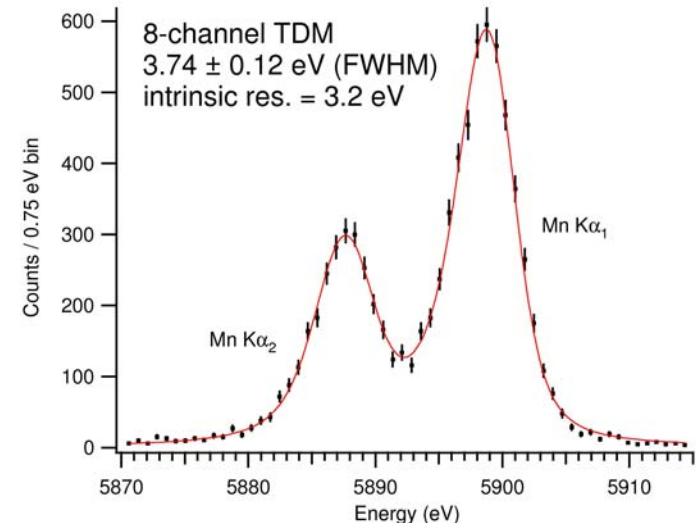
Row 1



Row 2



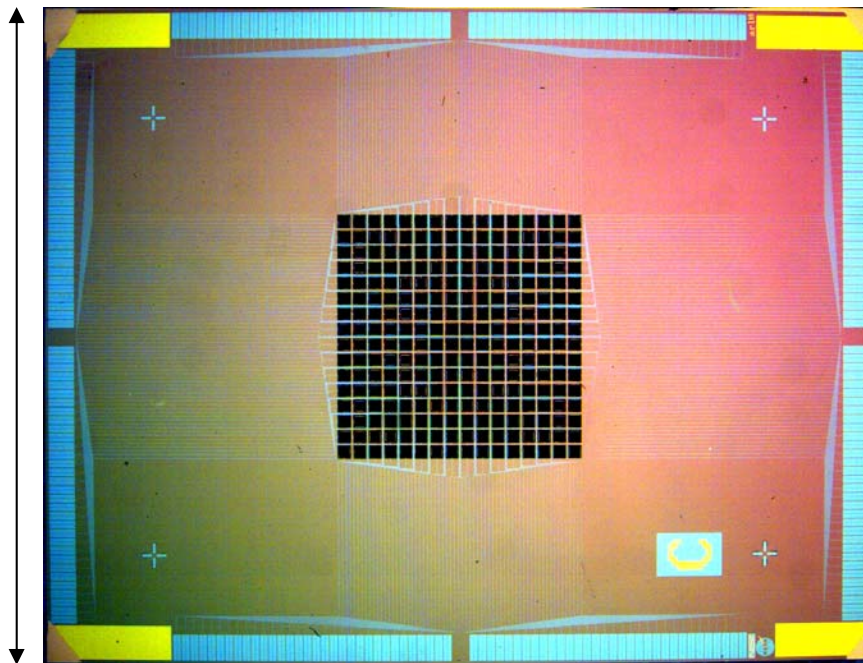
## Previous MUX status



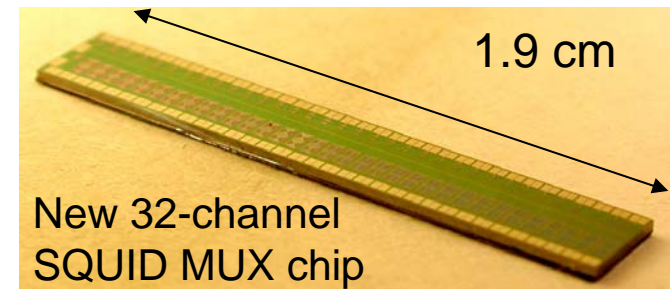


## The next step in scaling: $4 \times 32$

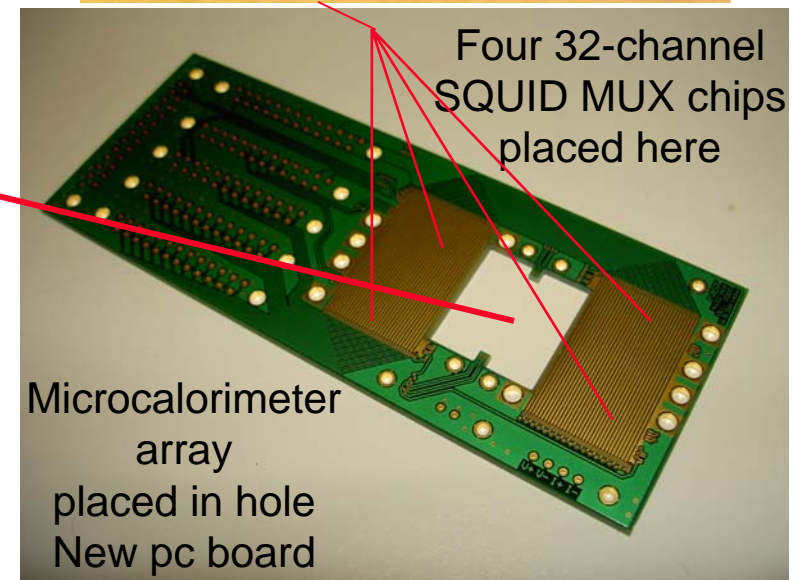
- $16 \times 16$  calorimeter array (1/4 the size of a Con-X baseline array)
- 4 new 32-channel MUX chips (we will MUX half of the array this time around)
- Room-temperature electronics revision to double the bandwidth
- We will not yet have the full Con-X performance, but we're closing in on it



New 256-pixel calorimeter array



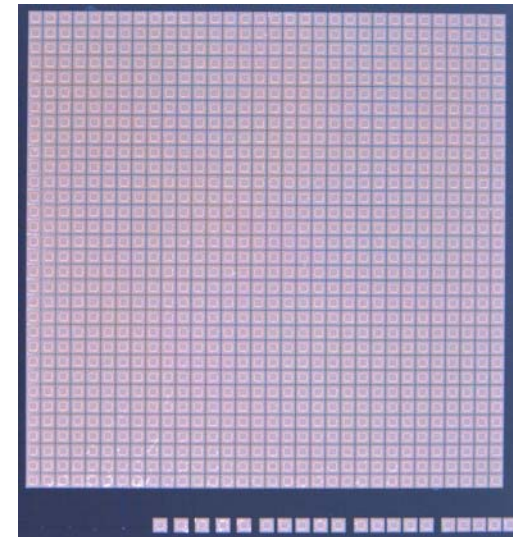
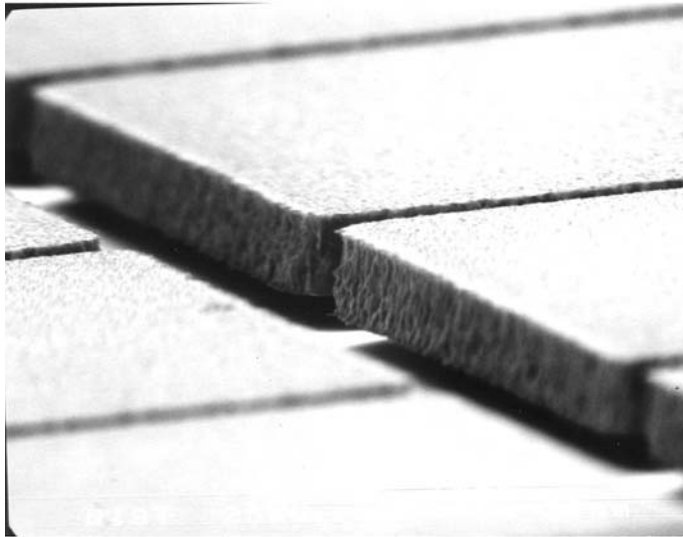
New 32-channel  
SQUID MUX chip



Microcalorimeter  
array  
placed in hole  
New pc board

Four 32-channel  
SQUID MUX chips  
placed here

## GSFC collaboration: “mushroom absorber” process transferred to NIST



32 x 32 array of Bi  
mushroom absorbers



Now integrating with TES...



# Constellation

The Constellation X-ray Observatory



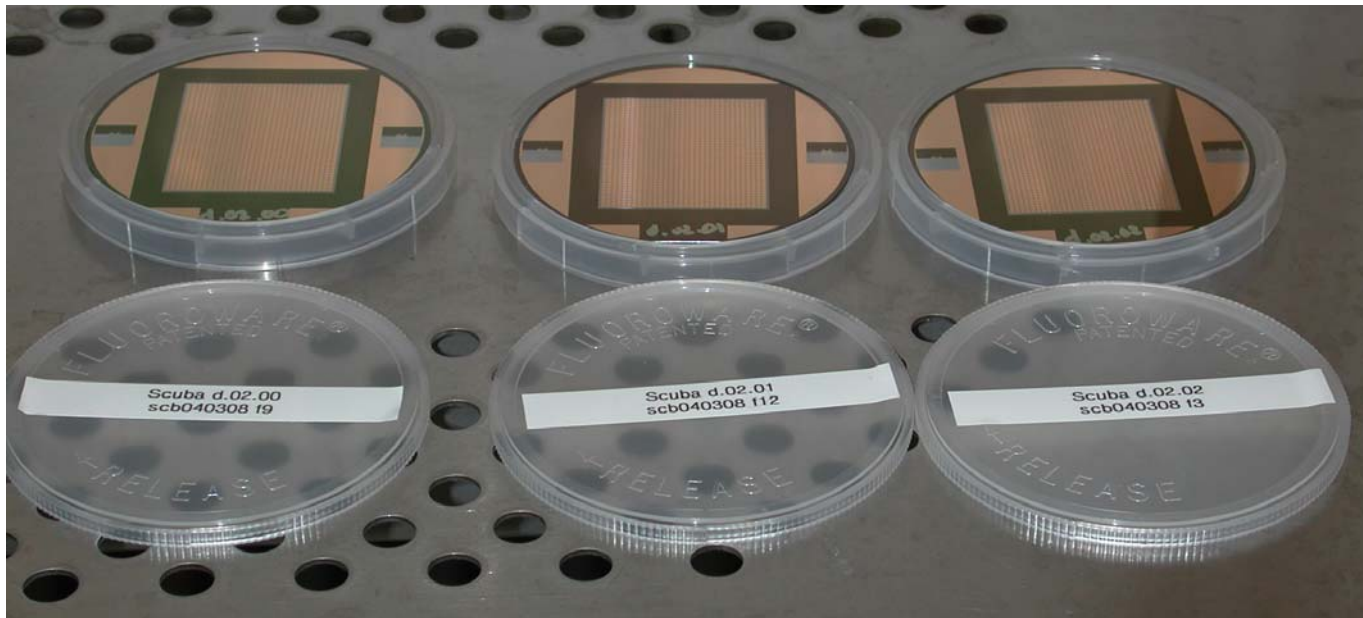
## TES Development at NIST for the XMS

*Kent Irwin*

*National Institute of Standards and Technology*

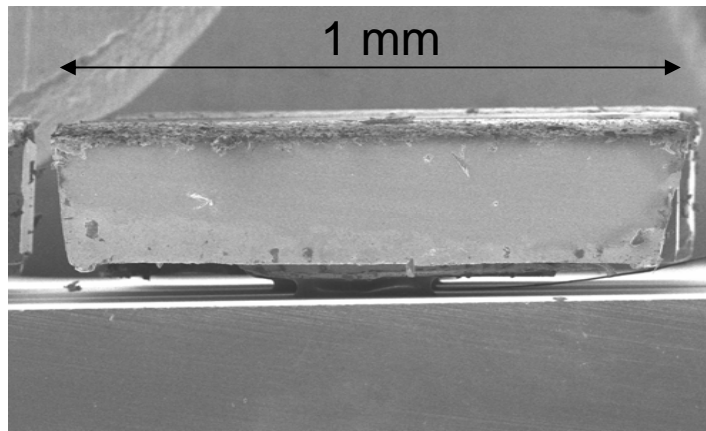


## SCUBA-2: pathway to larger TES arrays

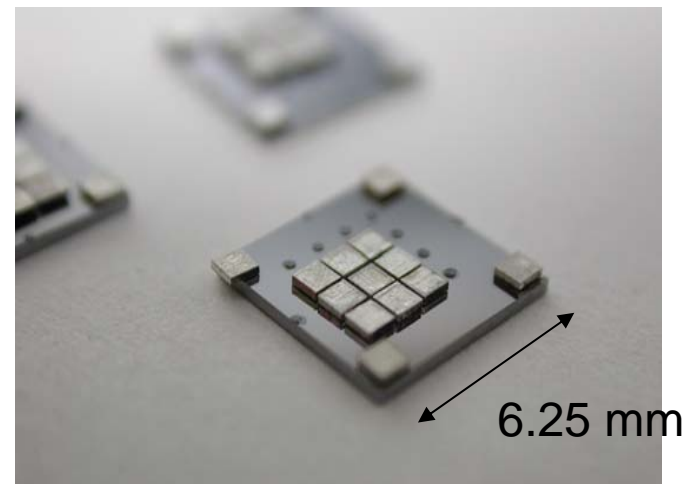


**Three 1,280-pixel TES subarrays for SCUBA-2**

## Hard x-ray TES calorimeters: 42 eV at 100 keV



**A single  $\gamma$ -ray TES  
detector pixel**



**An array of  
absorbers for  
 $\gamma$ -ray TES  
calorimeters**

## Hard x-ray TES calorimeters: 42 eV at 100 keV

Spectral resolving power: 4300 ( $E / \text{HEW}$ )

